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## Global Watershed Modeling

Grades 6 and up, estimated time for program a bit over an hour, leave out river models to reduce run time.

Education goals: Show the relationship between the economics of the nations and the global watershed of Earth. This program shows the impact people have on other people and the environment. It also shows how decisions are made that impact the watershed and the people living in the watershed

Equipment list and directions are for a class of 20-25 students divided into 4 groups.

### Equipment Needed:

#### For Part 1

4 containers to be global watersheds that should be clear. 4 cup measuring cups work well

Clear plastic cups for each group to have at least three. Each group should have one with a hole in the bottom of the cup. The others should be whole.

#### Food coloring

4 bags of filtering material of your choice, none of it has to work, but it's nice if some does. Some things used are dried leaves, sponge pieces, coffee filter paper, plastic dinosaurs, grass, sand, kitty litter.

Play money to give each group at least \$300 in several denominations

#### Water

#### For Part 2

4 flat containers to be the Mississippi watershed (disposable baking pans will work)

4 flat containers that fit in the Mississippi watershed and allow the construction of topography around them (Danish pastry pans minus the pastry will work). These are the river channel.

Plastic spoons for each student

#### Water

Enough sand to build topography in the baking pans around the Mississippi river channel, and to fill in the river channel

Fine mesh sieve

### Directions:

The program can be divided into two sections over two classes if you want, one is the global watershed, and the other is specific rivers and their issues. Leaving out a section such as specific river issues is better than cutting decision making off too early, or not leaving time for a "What did we get ourselves into?" reflection.

There can be splashing with this program and actions can be messy so try and do it outside or at least with a sink not far away. A big, fine mesh sieve, if you have one, works well for draining the Mississippi and Anacostia at the end.

## Part 1 The global market for water

Divide the class into 4 groups

Have the groups select their treasurer, and then divide the money among the group treasurers evenly. Give each group a container with an inch of clean water in it.

Explain the rules: They each have clean water to start with. However in the real world it doesn't last. Each group will be upstream and downstream from another group, (assign this so everyone has someone up stream and down stream) and those people will affect them and be affected by them.

Each group has the **option** of dumping legally up to ½ their polluted water into the stream of the one group downstream. This group **must** accept this pollution.

Each group has a population. Assign these so there is wide variation. For instance one watershed has 3 million people, another has 600, and the other two are between those extremes. The managers have to provide water for their population. Because they are all in arid regions, there will be no fresh water for 10 months when the snow melts.

In the real world, people buy and sell water between watersheds. They also dump **illegally** in watersheds where they can. If any group is surrounding their watershed, they can not be dumped on.

There will be no chasing, no splashing, and no fighting over watersheds, unlike real life.

Have them decide how to tell who wins or who loses this game. Is it the group with the most money, the most water, the least pollution? This can be interesting. Each group may make a different decision on how to tell who wins.

While they are deciding on how to tell what winning will be, drop a drop of food color in each container.

When they have decided how to tell who wins, announce that they have 30 seconds to decide to do the legal dump or not. Then they can take a minute to do their **legal** dumping **if the group has decided** to do so. Some groups may choose not to legally dump and this is ok, as long as everyone has the opportunity.

When they are finished, give the groups another two minutes to decide any other actions they want to take; buying, selling, holding, illegal dumping,. After the decision making time, give the groups at least 5 minutes to negotiate and take action. This can get intense so expect movement between groups at this point.

Call a halt to activity and take a look at the results. Who won or did they? Do they all have water for their population? If not, where are they going to get it, who will sell it to them, how much will it cost and is it better quality than they got rid of? Who wins and loses in this game? Had there not been pollution in the beginning of the game who would have won or lost?

**Part 2: Our Rivers are in Our Hands.** This section focuses on 3 specific rivers, each facing a different human accelerated problem. To save time this next part could be done on a different day or left out.

**The Colorado River** currently has so much water taken from it for agriculture, business, residents, and government use that it no longer has water enough to reach the mouth at the Gulf of California. Explain that sometimes a river simply isn't big enough to handle the needs of people living in the watershed.

To demonstrate how this can happen: Give each group spoons for each student, and 2 cups per group. One cup should have at least 30 spoons of water in the cup, and another cup should be empty. Have students count off 1 to 5 and remember their number. Explain that you are going to read who gets how much water from the Colorado River ( the full cup ) and for what purpose. When you read their number the students with that number are to take out the required numbers of spoons of water from the cup with water and put it into the empty cup.

All students who are 1: I raise cattle, chickens, grain, vegetables, and fruit for the nation. If I don't get enough water for my fields and animals people will starve, not just here, but all across the nation. I am agriculture and I get 10 spoons of water.

All students who are 2: I am the local car wash, laundromat, movie theater, shopping mall, grocery store, restaurant, gas station, bank, department store, and offices for people like lawyers, doctors and veterinarians. I need water for my patrons, my employees, and others for sanitation, and consumption. I don't waste water. I sweep my sidewalks instead of hosing them off, and I recycle water if it's safe. If I don't have water, people will not be able to live here. I get 4 spoons of water.

All students who are 3: I live here. I have a nice yard, a home with a kitchen and bathroom. I keep my home clean, and my yard looking nice. I'm careful not to waste water, but I have three teenagers and you know how they are about changing clothes and showers. I get 8 spoons of water.

All students who are 4: I am the hospitals, schools, swimming pools, recreation centers, government offices, police stations, fire stations, and other government agencies that make life here possible. If I don't get water, people will have to drive further for

services like schools, recreation centers, and hospitals polluting the air more. Fire departments and police may be too far away to be effective in helping people. The hospital and recreation center use lots of water for sanitation and to make the hot summers here better with pools and fountains. I get 8 spoons of water.

All students who are 5: I am the first residents of this area. I am the fish, the elk, the bear, the wolf, the hawks, and other wildlife that have used the river as our home for a very long time. There are fewer of us left because our homes have been destroyed, but those of us left need 2 spoons of water to survive.

Have students take a look at the water left in the Colorado River. Questions for discussion: Did one group get short changed? Was there any group not needed? Was there any group you would want to live without? Will you take the time and effort to explore ways to make sure all groups get water they need?

**The Mississippi River** uses the sand and two flat trays, one inside the other, a cup and a little extra sand, and the sieve.

Directions for each group: Begin by putting the smaller pan inside the larger one, and spread sand in the larger tray up to the edges of the smaller tray. The larger tray represents the surrounding watershed and the inner tray is the actual river channel. Make a few mounds for high ground and keep the sand higher at the outer edge of the outer pan farthest from the "river". Keep it low along the sides of the inner tray as wetlands along the river. This is the pre-Columbian Mississippi.

Each group uses a cup with water and a little sand added, to fill the inner pan until it overflows a little.

Explain They represented a flood on the early Mississippi.

For discussion: What happened to the sand in the bigger tray where in a real watershed people would live? Did it move? Is it wet? What happened to the water? If a group made the area along the inner tray quite low in comparison to the outer edges of the large pan, the flooding should have been localized along the river channel

Using the same amount of water, flood the river again, adding more sand to the water as sediment is now much more a problem than pre-Columbian times. Do this a couple of more times.

For discussion: Did more area get flooded? After a few floods, take a look at the topography. Has the inner pan representing the river bed filling with sand?

Explain: This is what is happening along the Mississippi, especially the lower Mississippi. In the 1800s, the river was straightened and dykes built to rush the water to the Gulf of Mexico to prevent floods. But the process of upstream and tributary erosion causing

the filling of the river channel didn't stop. Instead, over a hundred years later, the floods are worse. Now the government is buying land along the river to make wetlands, and adding twists and bends in the river where they can to slow the flow and allow wetlands to take the flood water. As a benefit, fish can use the wetlands for nursery areas, and migratory birds find a home there. People can enjoy canoeing or birding, or just being alone with nature there.

**The Anacostia River** This uses the global watershed containers with a bit of food colored water, three cups, one with a hole, money, and filtering material. Distribute the cup with a hole in it, the containers with food color and water, the money, the cup that catches water. Divide this all evenly. Distribute one type of filtering material. Dead leaves are good for this. Have other filter material ready to sell.

Explain: The Anacostia is a short river with a high concentration of people living on the land that drains into it, the watershed. The polluted water represents the Anacostia River as it is. Each group is a municipality that must make some decisions.

Is the river acceptable in its current condition?

How clean would the group like it to be?

How much are they willing to spend to get it that clean?

How much do they have that they can spend to clean the river?

Offer to sell them for \$100 a filter that may or may not clean their river. It may or may not suck up all their water and leave them with no pollution in their river, but no water either. Give them time for discussion.

After each group has made their decision, have them estimate the water they have in their river. Use the cup with the hole in it to hold the filter material and pour water from the pollution container into the cup holding the filter and catch it in the cup without a hole. After filtering using their existing or purchased filter material ask if their river is up to standards they find acceptable.

If a group wants to buy more filtering material sell it to them, but no credit. They can borrow from other groups however or pool resources.

Stop the activity and open a discussion when it looks like they are done or out of money. For discussion: Is the river up to their standards? Have they as much water as they started with or did they lose some in the filtering process? Was there enough money to do the job?

What would have been saved if the pollution had not been in the river?

If you have the leisure of time discuss what a clean river is. A lot of these kids are looking for a swimming pool or drinking water as a model of clean.

For discussion : What is clean water? Is it sparkling clear? Are there leaves in it? (If they think this is bad see how many drink tea) Trees protect a watershed by holding the soil so the water stays clear. However, they drop leaves into the water which may make it look brown, and increase the acidity, just like tea. Plants living in the water die and their leaves decay feeding animals in the river and downstream.

Explain: We use chemicals like ammonia and chlorine to get our water sparkling clean and kill all bacteria. A frog egg will die in water with low levels of chlorine, levels low enough we could drink it. Is this acceptable?

If there are fish, crustaceans, or bivalves in the river they will poop in it. If there is poop, bacteria will be in the river to recycle the poop. This cycle has been around a long time. Mussels, oysters, and clams in the Chesapeake Bay used to filter the entire system in a few days. The loss of so many of these species means it now takes over a year to do the same thing. Is this acceptable?

Do they want a dead, sparkling clean river or one that is home to plants and animals? If they want the dead river, point out that a good percentage of our oxygen comes from aquatic algae and plants in the ocean. Sparkling clean means less oxygen to breathe.

You can introduce this section with two closed containers. One holds tea, the other distilled vinegar. Without letting them open the lids, ask which they would drink. Then let them open the lids and smell. How many would change their minds?